ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 657726

Proj. ECN

S

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ○	D. Crumpler, Tank Farm Vadose Zone, HO-22, 372-9234	○ Yes ◉ No	7/13/01
Direct Revision ◉			
Change ECN ○			
Temporary ○			
Standby ○			
Supersedure ○			
Cancel/Void ○			

6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
Site-Specific SST RFI/CMS Work Plan Addendum for WMAs T and TX-TY	RPP Vadose Zone	N/A
9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	**10. Related ECN No(s).**	**11. Related PO No.**
RPP-7578, Rev. 1	N/A	N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Completed	12d. Restored to Original Condition (Temp. or Standby ECNs only)
○ Yes (fill out Blk. 12b) ◉ No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change — 13b. Design Baseline Document? ○ Yes ◉ No

Pages 4-4, 5-4, A-1, and A-9 were revised to reflect maximum depth of sampling and number of samples collected.

Figure 6-1 and page A-6 were revised to ensure schedule of field activities can be accomplished during fiscal year 2002.

14a. Justification (mark one)	14b. Justification Details
Criteria Change ◉	Changes required to reflect current field activity schedule and number and maximum depth of sampling.
Design Improvement ○	
Environmental ○	
Facility Deactivation ○	
As-Found ○	
Facilitate Const. ○	
Const. Error/Omission ○	
Design Error/Omission ○	

15. Distribution (include name, MSIN, and no. of copies)

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RELEASE STAMP

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ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 657726

16. Design Verification Required	17. Cost Impact		18. Schedule Impact (days)
	ENGINEERING	CONSTRUCTION	
○ Yes	Additional ○ $ _____	Additional ○ $ _____	Improvement ○ _____
◉ No	Savings ○ $ _____	Savings ○ $ _____	Delay ○ _____

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☐	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☐	Process Control Manual/Plan	☐
Safety Equipment List	☐	Cell Arrangement Drawing	☐	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐	Tickler File	☐
Environmental Report	☐	Inspection Plan	☐	_____	☐
Environmental Permit	☐	Inventory Adjustment Request	☐	_____	☐

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J.D. Crumpler	[signature]	7/13/01	PE		
Cog. Mgr. A.J. Knepp	[signature]	7/13/01	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other			Other		

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

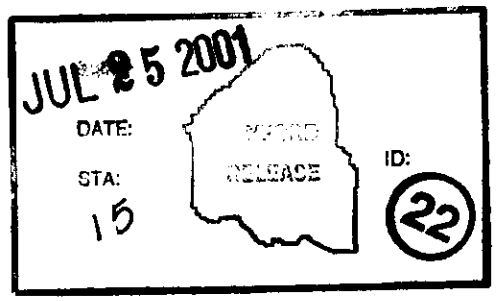
Site-Specific SST Phase 1 RFI/CMS Work Plan Addendum for WMAs T and TX-TY

J. Dwayne Crumpler
Jacobs Engineering Group, Inc
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: 657726 UC: 2010
Cost Center: 73500 Charge Code: 114631A010 -HFCH0601
B&R Code: EW3130010 Total Pages: 126

Key Words: RFI/CMS, vadose zone characterization, single shell tanks, waste management area, T tank farm, TX-TY tank farm

Abstract: This site-specific work plan addendum for WMAs T and TX-TY addresses vadose zone characterization plans for collecting and analyzing sediment samples.



Chris Willingham 7-25-01
Release Approval Date

Release Stamp

Approved For Public Release

RECORD OF REVISION

(1) Document Number: RPP-7578 Rev. 1A

(2) Title: SITE-SPECIFIC SST PHASE 1 RFI/CMS WORK PLAN ADDENDUM FOR WMAs T and TX-TY

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Initially released 3/9/01 on EDT 628947	D. Crumpler	A.J. Knepp3/9/01
1	Complete revision with incorporation of Ecology Comments per ENC-662650	J.D. Crumpler	A.J. Knepp 6/6/01
1A RS	Incorporated per ECN 657726. Replaced pages 4-4, 5-4, A-1, A-6 and A-9.	J.D. Crumpler DC	A.J. Knepp 7/13/01 7-9-01

SITE-SPECIFIC SST PHASE 1 RFI/CMS WORK PLAN ADDENDUM FOR WMAs T AND TX-TY

July 3, 2001

Prepared for
U.S. Department of Energy
Office of River Protection

Prepared by
CH2M HILL Hanford Group, Inc.

qualitative hypotheses on the specific sources of contaminant releases responsible for the observed groundwater contamination.

During the DQO process, the participants determined that the primary focus of the fiscal year 2002 data collection effort at WMAs T and TX-TY should be directed toward characterizing the contamination source in the vicinity of the probable largest releases. This effort should improve the understanding of tank leak inventory and distribution to support testing and refining a site-specific conceptual model for tank leaks and contaminant migration processes. A number of characterization technologies, including screening techniques, were considered. Because the current understanding of the distribution of radionuclides in the leak-contaminated vadose zone is still limited and is based primarily on indirect evidence, the focus of the fiscal year 2002 data collection program at WMAs T and TX-TY will be on sampling the vadose zone soils in areas of known tank leaks, spills, and overfill events within the tank farms and analyzing the samples for a range of contaminants of interest.

4.3 CHARACTERIZATION OPTIONS

The Tank Farm Vadose Zone Project technical team plans to use existing information and the characterization data collected during the Phase 1 characterization to develop a best basis or best estimate of the concentration and distribution of CoCs in WMAs T and TX-TY. This will involve the integration and synthesis of historical data, process knowledge, in-tank inventory models, and the characterization data collected during Phase 1. The integration and synthesis of these data will require interpolation and extrapolation due to the limitations of collecting samples within the tank farms. This effort will result in a conceptualization of CoC concentrations and distributions that would be used to evaluate human health and environmental risks.

Based on data needs identified in Section 5.0 of RPP-7455 and in the DQO meetings, a number of characterization options were considered for the fiscal year 2002 effort at WMAs T and TX-TY. These characterization options included installing new boreholes; decommissioning and/or extending existing boreholes; using direct-push technology; using auger drilling; and using nonintrusive geophysical techniques. These options are based on characterization techniques and innovative technologies identified in Section 6.3 of DOE/RL-99-36 for methods that have been successfully used on the Hanford Site. These options and potential deployment locations were evaluated in terms of the type of information that could be provided, as well as the technical risk associated with deployment during fiscal year 2002. Although all of the options considered could provide valuable data that would serve to improve the understanding of subsurface contamination, a number of the options were considered to be of lesser value or not feasible due to technical risk for the characterization effort to be implemented in fiscal year 2002. The list of characterization options considered during the DQO process, along with the rationale for including or omitting each option from the fiscal year 2002 effort, is provided in RPP-7455.

The characterization options selected for implementation at WMAs T and TX-TY during fiscal year 2002 are provided in Table 4.1 and consist of vertical borehole installation near selected tank waste releases. Table 4.1 includes the sampling method, implementation design, and rationale. The DQO process identified three sites for installation of vertical boreholes,

(tanks T-106, TX-105, and TX-107). Based on comments received on RPP-7455 from Ecology, the vertical borehole at tank T-106 has been reprioritized and is not included in fiscal year 2002 vadose zone characterization efforts. This initial (Phase 1) site-specific investigation to be conducted in fiscal year 2002 is anticipated to entail the installation of three vertical boreholes near tanks TX-105 and TX-107. An additional vertical borehole may be installed in fiscal year 2002 provided funding is available and its installation is consistent with other schedule priorities.

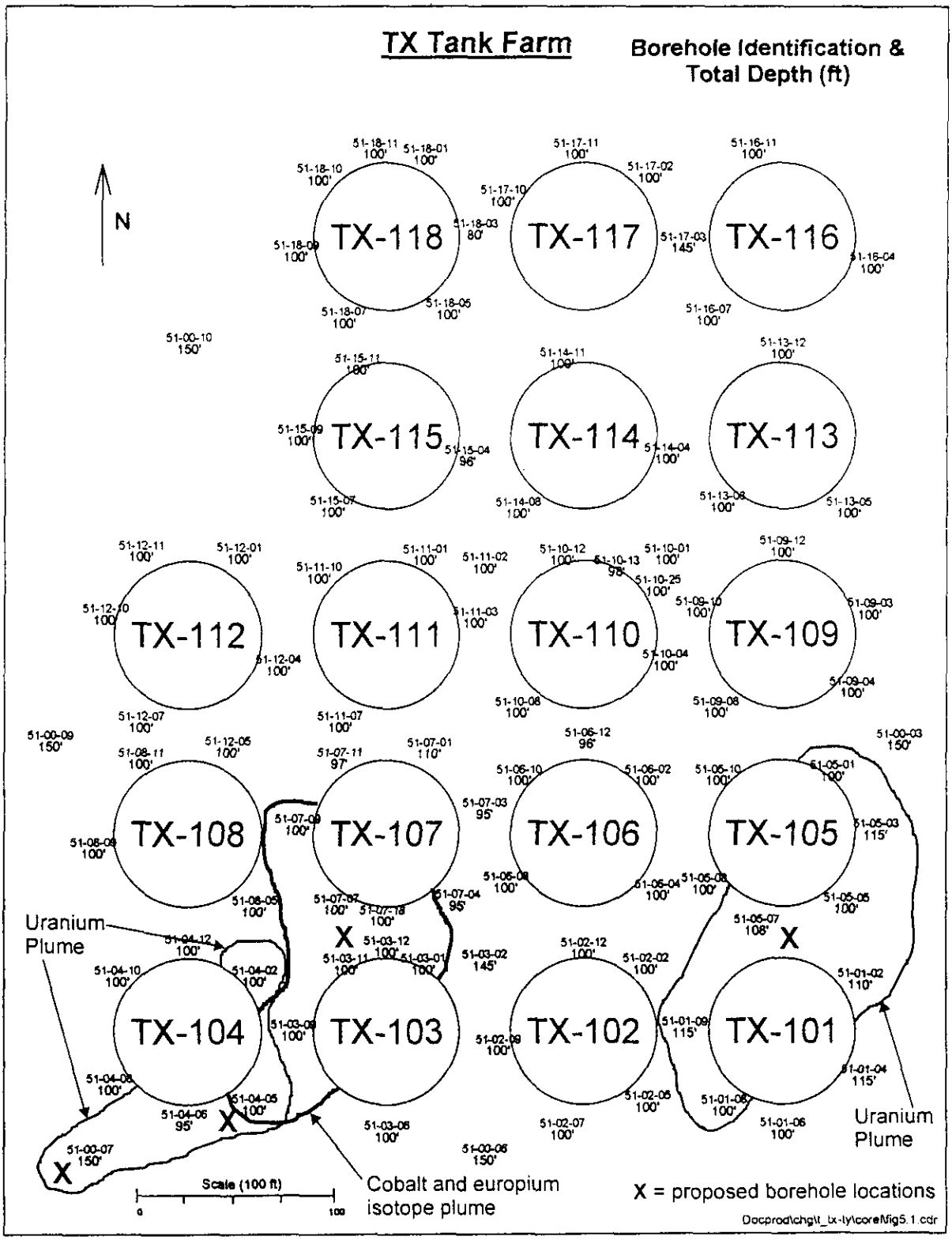
4.3.1 Installation of Vertical Boreholes

Several options were considered for collection of deeper vadose zone data. The preferred option was installation of vertical borehole(s). Three locations, in the vicinity of tanks TX-105 and TX-107, will receive boreholes as part of the initial site-specific investigation in fiscal year 2002. An additional location inside WMA TX-TY boundaries (east of tank TX-105 or southwest of tank TX-107) associated with known past releases (Table 4.1) may receive a borehole provided adequate funding and sufficient schedule are available. If this additional borehole is not conducted in fiscal year 2002, attempts will be made to install this and an additional two other boreholes in fiscal year 2003 or during Phase 2 characterization activities, depending on decisions made by Ecology and DOE. The potential target areas around tanks TY-105 and TY-106 for future field investigations would be considered again at this time. Vadose zone samples would be collected as the borehole(s) are advanced down to the top of the Ringold unit E (47 m [150 ft] bgs)or maximum extent of contamination, whichever is deeper unless refusal is encountered. Determination of maximum extent of contamination will be through gamma screening of cuttings or soil samples with non detect gamma indication for 1.5 m (5 ft). This option was selected because a vertical borehole at these locations (i.e., in the vicinity of tanks TX-105 and TX-107) would provide source characterization along with distribution of contaminants at the locations of interest from within WMAs T and TX-TY. Source characterization would do the following:

- Provide a basis for estimating contaminant inventories and processes that would control the migration of contaminants
- Support evaluation of the correlations between concentrations of CoCs and existing gamma data, and potentially support evaluation of the relationship between the CoCs in the soil and the concentrations of CoCs present in the tanks at the time the leaks were believed to occur
- Support assessment of contaminant mobility; potential drivers (e.g., moisture content); and the effects of tank leaks on soil properties to support predictive numerical modeling efforts necessary to evaluate potential future groundwater impacts, the associated risks, interim corrective measures, and further characterization as warranted.

Source characterization efforts also would involve identifying what contaminants are present and, subsequently, identifying the potential CoCs for corrective action, retrieval, and closure decisions. If correlations between the CoCs and available gamma data can be established, there is a potential that the wealth of existing gross gamma and spectral gamma data can be used to better understand the location and distribution of CoCs in the vadose zone.

Figure 5.1. WMAs T and TX-TY Proposed Sampling Locations for Vertical Boreholes



Modified from RPP-6353.

The current planning basis for the vertical boreholes south of tanks TX-105 and TX-107 includes driven samples that will be collected. The samples will be transported to the laboratory and analyzed for the CoCs identified in Appendix A. Nominally, 21 horizons will be sampled based on the geophysical surveys or the need to provide depth coverage as identified in Appendix A.

Subsurface conditions are variable and the process of installing the vertical boreholes must be flexible. Some or all of the work described in Appendix A may require modification. This addendum is intended to serve as a guideline and is designed to allow for changes depending on conditions encountered in the field. Any change will be recorded on the appropriated field documentation, memoranda, or letters. A complete documented record of activities will be maintained for preparation of a final summary report.

Appropriate permits and compliance with the Notice of Construction permit (DOE/ORP-2000-05) will be maintained during the drilling operations for inside the tank farm. The selected drilling method will comply with the requirements of the Washington State Department of Health for the Notice of Construction permit and other pertinent requirements and appropriate engineering systems to prevent the possible contaminated air from being released to the environment.

5.2.2 Subtask 2b – Laboratory Analysis

Laboratory analyses to be conducted for the WMAs T and TX-TY geologic and vadose zone investigation are described in Appendix A. These analyses will include radiological and chemical analysis of selected sediment samples. Physical and hydrologic analysis of selected sediment samples will also be performed.

5.3 TASK 3 – DATA EVALUATION

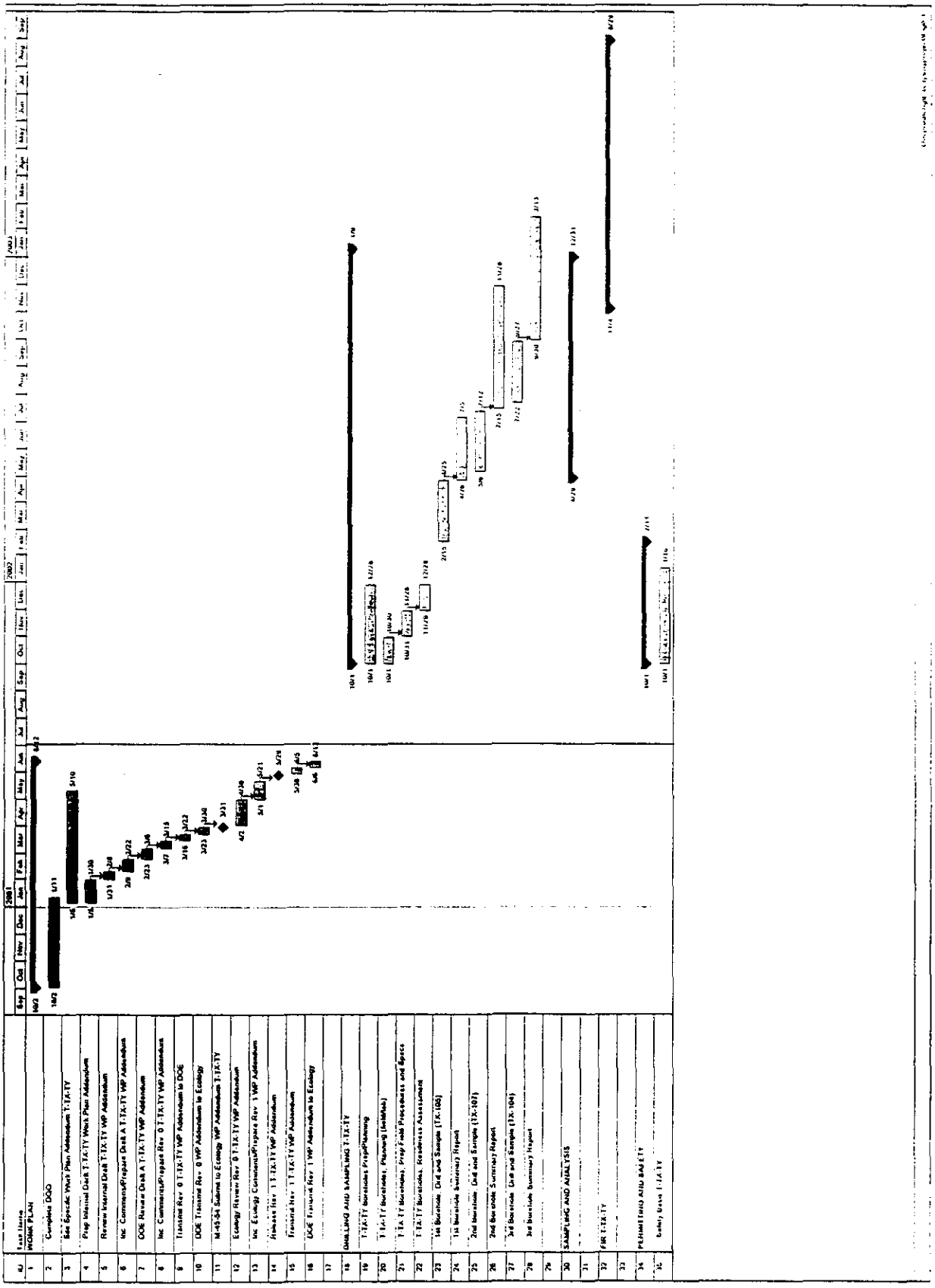
Data generated during the field investigation will be integrated and evaluated, coordinated with RFI activities, and presented in an ongoing manner to allow decisions regarding any necessary rescoping to be made during the course of the project. The assessment of data against the DQOs, use of the data by others, and to support future activities will be conducted and documented in a field investigation report for WMAs T and TX-TY (Ecology et al. 1999). The results of these evaluations will be made available to project management personnel to keep project staff informed of progress being made. The interpretations developed under this task will be used to refine the conceptual model and to determine whether interim measures or ICMs are warranted for WMAs T and TX-TY through a field investigation report for WMAs T and TX-TY to fulfill Tri-Party Agreement Milestone M-45-55-T03.

6.0 SCHEDULE

The work described in Section 5.0 is detailed in the schedule for developing plans and conducting field activities. The schedule, shown in Figure 6.1, is the baseline that will be used to measure progress. The characterization activities described in this addendum were identified during a DQO process to fulfill proposed Tri-Party Agreement Milestone M-45-54 to be completed by March 2001. Activities were planned using the work breakdown structure and project milestones defined in Section 7.0 of DOE/RL-99-36.

Based on DOE guidance for establishing a baseline scope, schedule, and budget document, the use of a multi-year work plan was adopted. The activities identified in Figure 6.1 were taken from the multi-year work plan, which is updated annually and describes the specific details associated with each proposed project. The multi-year work plan incorporates milestones defined in the Tri-Party Agreement and reflects the schedule and commitments made therein. The multi-year work plan defines the scope, schedule, and budget to a level of detail that will be adequate for the planning and management of that project. The work breakdown schedule numbers and activity identification numbers are included in Figure 6.1 to correspond with the schedule maintained by the Tank Farm Vadose Zone Project. The planned field investigation report for WMAs T and TX-TY that will address interim measures and ICMs is scheduled for submittal to Ecology on June 30, 2003 (Figure 6.1).

Figure 6.1. Preliminary Characterization Schedule



A.1.0 INTRODUCTION

The focus of this Sampling and Analysis Plan (SAP) is vadose zone investigation of waste management areas (WMAs) T and TX-TY, which contain the T, TX, and TY tank farms. Sampling and analysis of vadose zone sediments will occur in the vicinity of the T, TX, and TY tank farms to meet the objectives of this investigation.

This plan details the field and laboratory activities to be performed in support of the investigation of vadose zone contamination in WMAs T and TX-TY and is designed to be used in conjunction with the work plan and referenced procedures. The field investigations at WMAs T and TX-TY addressed in this SAP are for installation of vertical boreholes. The data quality objective (DQO) process (RPP-7455) resulted in the identification of several potential locations for proposed new boreholes. This initial (phase 1) site-specific investigation to be conducted in fiscal year 2002 is anticipated to entail the installation of three vertical boreholes.

The new boreholes will be installed using a variation of the drive-and-drill drilling technique. Staged (telescoping) casings may be used to reduce the likelihood of cross-contamination from penetrating through the highly contaminated zones. The final borehole construction and sampling methodology for the vertical boreholes in WMAs T and TX-TY will be designed to maintain compliance with the requirements of the Notice of Construction (DOE/ORP-2000-05) for drilling operations inside the tank farms.

Collection of spilt-spoon driven samples will be attempted from about 4.6 m (15 ft) below ground surface (bgs) to top of the Ringold Formation unit E gravels approximately 45.7 m (150 ft) bgs or the maximum extent of contamination, whichever is deeper on 3-m (10-ft) intervals. Continuous drill cutting samples will not be collected, because drill cuttings are not produced by the proposed drilling method unless for the purpose of sampling. This drilling method will reduce contaminated soils brought to the surface and requiring disposal for the waste management requirements in Appendix D of *Phase 1 RCRA Facility Investigation/Corrective Measures Study Work Plan for Single-Shell Tank Waste Management Areas* (DOE/RL-99-36). Selected portions of the samples will be analyzed for chemical, radiological, and physical characteristics. A suite of geophysical surveys will be performed. The boreholes will be decommissioned in accordance with Washington State "Minimum Standards for the Construction and Maintenance of Wells" (WAC 173-160).

Technical procedures or specifications that apply to this work include Duratek Federal Services sampling and geophysical surveying procedures (SML-EP-001), sample and mobile laboratories procedures (SML-EP-001), and vadose zone characterization at the Hanford Site tank farms, high-resolution passive spectral gamma-ray logging procedures (P-GJPO-1783). All field and laboratory work prescribed by this SAP shall also be in conformance with *Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68). Field and laboratory personnel should be familiar with these documents, as appropriate, and maintain a copy for guidance during work activities.

The field activities related to this investigation comprise vadose zone sampling geophysical logging and sample analysis. This SAP addresses the requirements of the vadose zone sampling and analysis.

The quality assurance project plan, Appendix A of DOE/RL-99-36, is an integral part of the SAP and must be used jointly. RPP-7455 references the sampling analytical quality assurance and quality control requirements that must be used to obtain representative field samples and measurements. Knowledge of the health and safety plan (Appendix B of DOE/RL-99-36) is required by those involved in the field sampling because it specifies procedures for the occupational health and safety protection of project field personnel. The data management plan (Appendix C of DOE/RL-99-36) denotes the requirements for field and laboratory data storage. The waste management plan (Appendix D of DOE/RL-99-36) denotes the requirements for the management of waste and the appropriate collection, characterization, and designation of waste produced by the characterization activities.

A.2.0 INSTALLATION OF VERTICAL BOREHOLES (WELL NUMBER TBD)

The following is a discussion of the field tasks and associated subtasks required for the drilling, sampling, and sample analysis associated with the vertical boreholes.

A.2.1 PROJECT MANAGEMENT (TASK 1 OF SECTION 5.0)

Project management will be followed as described in DOE/RL-99-36.

A.2.2 GEOLOGIC AND VADOSE ZONE INVESTIGATION (TASK 2 OF SECTION 5.0)

The geologic and vadose zone investigation task has two subtasks relevant to the installation of the new boreholes: Subtask 2a, field activities, and Subtask 2b, laboratory analysis. The following subsections describe these subtasks.

A.2.2.1 Field Activities (Subtask 2A of Section 5.0)

The field activities addressed in this subtask required to support the geologic and vadose zone investigation are drilling, geophysical logging, sediment sampling, and reporting activities.

A.2.2.1.1 Drilling Activities. Drilling will be conducted using specifications and guidance in accordance with "Minimum Standards for the Construction and Maintenance of Wells" (WAC 173-160). Drilling operations will also conform to SP 4-1, "Soil and Sediment Sampling"; WP 2-2, "Field Cleaning and/or Decontamination of Equipment"; and the task-specific work package that will be generated for these field activities (ES-SSPM-001). The work package will contain such information as borehole construction, sampling technique, and radiation protection. All waste will be handled in accordance with the requirements of WAC 173-303 and/or the site-specific waste control plan. These techniques are based on minimizing the exposure of field personnel to both radiation and chemical pollutants to as low as reasonably achievable and in compliance with regulatory requirements.

All split-spoon samples will be collected in advance of the casing being driven. Driven split-spoon samples will be attempted at a maximum of every 3-m (10-ft) intervals beginning at 9 m (30 ft) bgs. The casing is to be driven to total sample depth at the end of each day's drilling effort to prevent potential hole collapse. Split-spoon samplers will be new or decontaminated before reuse. Procedures for decontamination of sampling equipment are contained in WP 2-2, "Field Cleaning and/or Decontamination of Equipment" (ES-WSPM-001).

The depth of the vadose zone borings will be to the top of the Ringold Unit E member or maximum extent of contamination whichever is deeper, unless refusal or perched water is encountered. If the U.S. Department of Energy desires to continue the borehole through a perched water zone, then Ecology would be notified. The use of field screening instruments will be used for evaluating alpha-, beta-, and gamma-emitting radionuclides. Radiological screening is expected to be effective in determining the initial extent of contamination.

In addition to the borehole geologic logging, radiation measurements will be made using hand-held instruments on each segment of sample recovered during sampling and on the drill cuttings brought to the surface. Blow count measurements will be collected during all drive samples collected while advancing the split-spoon sampler. General observation will be noted as to drilling progress and problems. All of this information will be included in each borehole geologic log. Borehole geologic logs and well summary sheets will be prepared in accordance with approved Duratek procedures using American Society for Testing and Materials procedures (ASTM D2488).

A geologist will prepare a geological log for the vertical boreholes, based on the sediment samples. Borehole geologic logs will be prepared in accordance with approved procedures. The geologic log will include lithologic descriptions, sampling intervals, health physics technician hand-held instrument readings, screening results, evidence of any alteration of sediments, and general information and observations deemed relevant by the geologist to the characterization of subsurface conditions. Sediment samples will be screened with hand-held instruments for radiation, as appropriate, using techniques and procedures defined in the work package. Screening results and general observations as to drilling progress and problems will be included in each borehole log.

Waste containing unknown, low-level mixed radioactive waste and/or hazardous waste will be contained, stored, and disposed of in accordance with Appendix D of DOE/RL-99-36, or the most current procedures approved by Ecology, including waste utilizing the area of contaminant approach, and as specified in the quality assurance project plan (Appendix A of DOE/RL-99-36). These activities will be documented in the field activity reports. Waste will be disposed of at the Mixed Waste Burial Grounds in accordance with Appendix D of DOE/RL-99-36. All important information will be recorded on field activity report forms per approved procedures. The field activity report form includes borehole number, site location drawings, drawing of the downhole tool strings, site personnel, sampling types and intervals, zones noted by the health physics technician as elevated in radiological contaminants, instrument readings will be noted and the depth represented by those readings, and specific information concerning borehole completion.

The new boreholes will be decommissioned in accordance with WAC 173-160 following completion of geophysical surveys. All temporary steel casing removed from the boring will be surveyed and either decontaminated and released or transferred to an appropriate disposal facility. Specific procedures for borehole abandonment will be documented in the field work package. These procedures will comply with U.S. Environmental Protection Agency (EPA) requirements and WAC 173-160.

Should the contamination extend all the way to groundwater and drilling to groundwater is feasible (i.e., refusal does not occur), the new boreholes may be completed as a *Resource Conservation and Recovery Act of 1976* (RCRA)-compliant groundwater monitoring wells. A groundwater sample will be collected and analyzed based on current groundwater analysis for WMAs T and TX-TY. Should technetium-99 concentrations exceed 10 times (9,000 pCi/L) the drinking water standard (900 pCi/L) a RCRA-compliant groundwater monitoring well will be installed. If so, the new wells will be included in the RCRA groundwater monitoring network for routine groundwater sampling and analysis. If not completed as RCRA-compliant groundwater wells, then the boreholes will be decommissioned in accordance with WAC 173-160.

Should the contamination extend deeper than 47 m (150 ft) bgs drilling will cease on that borehole and move to the next borehole. A discussion with Ecology on how to proceed with a different drilling method and schedule will be conducted to stay on the schedule of drilling and sampling three boreholes in fiscal year 2002.

If completed as a groundwater monitoring well, a 4-in. stainless steel casing and screen will be permanently installed, and a flush mount surface protection/well seal will be constructed. The well will be completed in accordance with WAC 173-160 requirements to meet groundwater protection goals. Specific work steps for well completion will be documented in the tank farm work package.

Contaminant dragdown during drilling and sampling activities is unavoidable and has been observed in recent sampling activities. Different drilling and sampling techniques will impact dragdown to varying degrees. Because the objective of the characterization activities identified in the DQO is to safely sample in and below regions of known leakage, the dragdown issue is a secondary concern. However, appropriate drilling procedures will be used to minimize the effect of contaminant dragdown.

A.2.2.1.2 Geophysical Surveying Activities. Based on sampling and construction methods, downhole spectral-gamma or gross gamma geophysical logging will be conducted to ascertain the gamma-emitting radionuclide concentrations. The spectral-gamma or gross gamma logging frequency will be directed by CH2M HILL Hanford Group, Inc. (CHG).

A suite of geophysical logs, as determined by the CHG Field Team Leader, will be run any time the casing size is changed and at the completion of the borehole. This will provide some flexibility with the planning of geophysical logging during the drilling process.

The following logging techniques could be used for the vertical boreholes:

- Gross-gamma logging to support correlation of confining layers and stratigraphy
- Spectral-gamma logging for measuring the distribution of selected radionuclides
- Neutron logging for measuring the relative moisture content.

laboratory analysis will be transported under chain of custody in accordance with the quality assurance project plan.

Sediment cuttings containing low-level and mixed radioactive waste will be contained, stored, and disposed of according to procedures defined in Appendix D of DOE/RL-99-36. Sediment cuttings containing hazardous waste and those containing unknown waste will be contained and disposed of at the mixed waste burial grounds in accordance with Appendix D of DOE/RL-99-36. Storage of archive samples will be done until approval to dispose of the samples is provided by the CHG technical representative.

Geologic logging for the vertical boreholes will be conducted as it was for the borehole 41-09-39 extension in WMA S-SX. Specifically, once sample material from the vertical boreholes is received at the laboratory, and it will be geologically logged by an assigned geologist in general conformance with standard procedures. The assigned geologist will photograph the samples and describe the geologic structure, texture, and lithology of the recovered samples. Special attention is to be paid to the presence of contaminant alteration. If such a phenomenon is noted, that sample will be noted, preserved for more detailed physical, chemical, and mineralogic analyses, and recorded in the laboratory notebook.

Sediment subsamples for laboratory analysis will be defined by location in the sample after the field screening and geologic logging have been completed and indication of contamination locations have been identified. Approximately 21 sediment subsamples from each of the boreholes will be chosen for screening analysis. The following criteria will be used to identify subsamples for laboratory analysis based on concurrence with Ecology:

- One subsample will be taken at 4.6 m (15 ft) bgs.
- One background subsample will be taken at 9 m (30 ft) bgs.
- One subsample will be taken at 11.9 m (39 ft) bgs, at the level of the tank bottom.
- One subsample will be taken at the Hanford formation and Hanford formation(?)/ Plio-Pleistocene unit(?) interval contact at approximately 24.4 m (80 ft) bgs.
- One subsample will be taken at the Hanford formation(?)/Plio-Pleistocene unit(?) interval and Plio-Pleistocene unit contact at approximately 29.9 m (98 ft) bgs.
- One subsample will be taken at the Plio-Pleistocene unit and Upper Ringold Formation contact at approximately 32 m (105 ft) bgs.
- One subsample will be taken at the Upper Ringold Formation and Ringold unit E contact at approximately 36.8 m (121 feet) bgs.
- Subsamples will be taken of any paleosols seen in the split-spoon drive samples.
- Subsamples will be taken in locations where elevated or altered gamma surveying or moisture content was measured during the geological and geophysical borehole logging process.

- At least one subsample will be taken every 3 m (10 ft) if samples have not already been taken, based on the above criteria to ensure continuous distribution and lithologic completeness.

Table A.1 shows the subsamples identified for laboratory analyses. Worker safety considerations may limit the collection of samples at certain intervals. A 1:1 water extract of all subsamples shall undergo screening analyses. Screening analyses comprise the following:

- Nitrate analysis by the colorimetric method
- Electrical conductance
- Total organic carbon/total carbon
- gamma energy analysis
- pH.

These analyses, along with the gamma surveying and moisture content measurements performed during the field geophysical surveys and the laboratory geologic logging, will be used to determine the extent of further subsample analysis. Table A.2 identifies the full complement of potential analyses and their respective laboratory preparation and analytical methods.
This paragraph and the remainder of this appendix identify which analysis will be conducted on which sample. If more than one preparation or analytical method is listed, the expertise of the laboratory geochemistry staff will be used to determine which methods will produce the best results and will provide the best understanding of the chemistry involved. For those methods that produce multiple constituents (i.e., inductively coupled plasma), all constituents identified will be reported. Every effort is to be made to meet regulatory holding times where appropriate. The DQO process identified the need for volatile organic analysis and semivolatile organic analysis. An attempt will be made to perform these analyses; however, based on experience from WMA S-SX, it is unlikely that the holding time for volatile organic analysis can be met.
If holding times cannot be met, analysis of these compounds will not be performed. Based on previous experience, it is anticipated that holding times for the semi-volatile organic analysis can be met.

Because the purpose of the new borehole analyses is to gain an understanding of the nature and extent of contamination, the fate and transport of the contaminants in the vadose zone and to produce *Resource Conservation and Recovery Act of 1976*-compliant data, the analysis of these subsamples comprises two levels. The baseline level involves analysis of organic, inorganic, and radiochemical constituents in full conformance with DOE/RL-96-68 and with no modifications to methods (as defined by DOE/RL-96-68) without concurrence from the CHG technical representative and from Ecology. Substitutions and deviations to methods as defined in DOE/RL-96-68 will require concurrence from Ecology. The second level involves a research-type approach to the analyses. In this level, procedures may be modified or developed to gain a more comprehensive understanding of the dynamics involved. Although specific quality control criteria do not apply to this level, compliance with the other quality assurance requirements in DOE/RL-96-68 must still be met and research analysis will be initiated only following review and approval of the activities by the CHG technical representative.